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COMMEL II USER'S MANUAL. VOLUME IV. ELECTRONIC WARFARE ADDENDUM--ETC(U)
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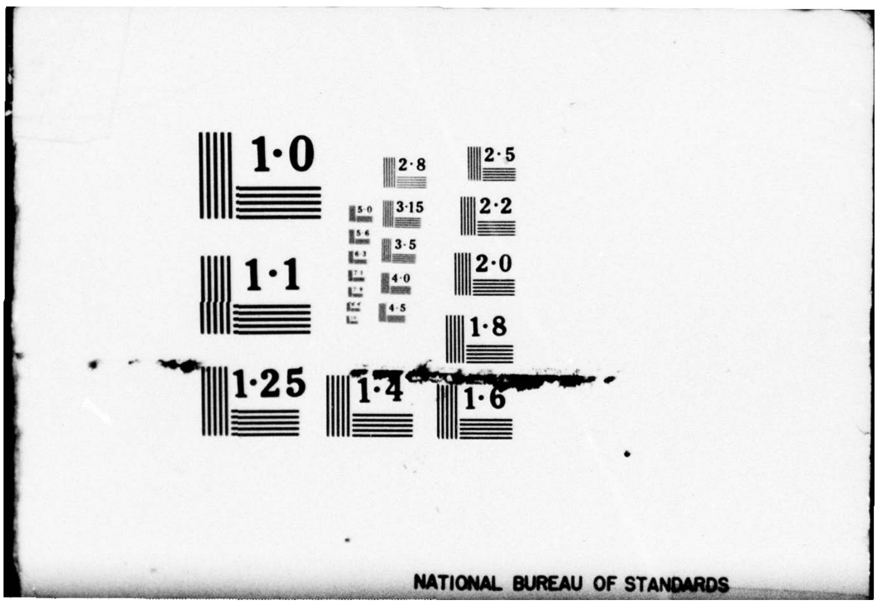
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Electronic Warfare	COMMEL Model
ECM	Communications-Electronics
ESM	Computer simulation
Jamming	Simulation
Direction finding	Tactical communications analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This document is an addendum to the COMMEL II User's Manual, Volumes I (AD-A031613), II (AD-A031614), and III (AD-A031615). This addendum contains those changes necessary to Volumes I-III to reflect the modifications to the COMMEL (Communications-Electronics) II Model to incorporate the capability to analyze the interactions of electronic warfare (EW) with division communications in a combat simulation; this EW version of the model is designated COMMEL II.5. over

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20. (continued)

The original volumes (I-III) of the manual were designed to assist military and operations research analysts in the use of the COMMEL II Model and in the preparation of the input data base for the model. The COMMEL Model is a fully computerized combat simulation which includes a dynamic interface between division tactical operations and communications. The model output provides statistics on both communications system performance and combat outcome. The COMMEL Model simulates division-level combat with resolution to company level. Tactical and communications activities are represented by four interrelated submodels which periodically transmit event statistics to output files. The model is basically deterministic although message routing factors may be varied through use of a random number generator.

LEVEL III

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COMMEL II USER'S MANUAL

VOLUME IV - ELECTRONIC WARFARE ADDENDUM

(COMMEL II.5 VERSION)

JULY 1978

Prepared by

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Systems Force Mix Directorate
8120 Woodmont Avenue
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COMMEL II.5 USER'S MANUAL

ADDENDUM INSTRUCTIONS

1. Purpose. Since publication of the original COMMEL II User's Manual in 1976 (Volumes I, II and III), additional capabilities have been added to the model to incorporate abilities to analyze the effects of electronic warfare (EW) in division combat through EW interaction with communications. This addendum (Volume IV) to the User's Manual documents those model changes implemented in developing the EW version of the model (COMMEL II.5).

2. Addendum Design

a. This addendum has been designed to be taken apart, with the pages to be inserted in the appropriate sections of the original three volumes of the COMMEL II User's Manual; some pages are replacment pages and some are new pages. The page numbers at the bottom of each page relate to the original volumes into which they are to be inserted.

b. In addition to replacement/new pages, certain pen and ink changes are required to be made to the front sections of the original volumes; these are enumerated in a following section of this report.

3. Future Changes Further modifications to the model are currently in progress which are intended to incorporate additional electronic warfare analytical capabilities. Formal documentation of these modifications through another addendum to the User's Manual is not planned before 1979. Future inquires into the state of the model and its capabilities should be addressed to:

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COMMEL II USER'S MANUAL

VOLUME IV - ELECTRONIC WARFARE ADDENDUM
PEN AND INK CHANGES (FIRST REVISION) TO VOLUMES I-III

Accomplish annotations cited below in Volumes I-III of the COMMEL II User's Manual to update that manual to the COMMEL II.5 version of the model.

Page	Change
Covers (Volumes I-III)	"COMMEL II" to "COMMEL II.5"
Title Page (Volumes I-III)	"COMMEL II" to "COMMEL II.5"

COMMEL II USER'S MANUAL

VOLUME IV - ELECTRONIC WARFARE ADDENDUM
DELETIONS/ADDITIONS (FIRST REVISION) TO VOLUMES I-III

1. Remove the old pages and insert the new pages, as shown below, in the appropriate volume of the COMMEL II User's Manual to update that manual to the COMMEL II.5 version of the model.

2. In the case of revisions to the Table of Contents, sufficient copies of each new/replacement page have been provided to accommodate each of the three (3) original volumes (I-III).

Remove Pages	Insert Pages
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viii, ix, x	viii, ix, x, x(a)
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viii, ix, x	viii, ix, x, x(a)
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C-2, C-3, C-4, C-5, C-6	C-2, C-3, C-4, C-4a, C-4b, C-5, C-6, C-6a
None	D-1, D-2
None	E-1, E-2, E-3
None	F-1, F-2, F-3, F-4, F-5
None	G-1, G-2, G-3, G-4, G-5, G-6
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CHAPTER I
INTRODUCTION

1. Purpose and Background

a. This document contains the information required to enable non-ADP oriented military analysts and operations research analysts to utilize the COMMEL Model and to develop and formulate the required data to activate the model. It does not contain an in-depth description of the theory used to develop the model or a description of the programing techniques contained in the model.

b. The descriptions and definitions contained herein concern the model as it exists and do not address any possible revisions that may be under consideration.

c. The basic text of this document was prepared by Evaluation Technologies, Incorporated (ETI) in January 1976 under contract to the US Army Concepts Analysis Agency (CAA). The Manual was updated by CAA prior to publication based on experience gained while using the model in early 1976. Subsequently, CAA revised the Manual to reflect modifications and improvements to the model (notably in the simulation of electronic warfare) which resulted in a version of the model, designated COMMEL II.5.

2. Model Description

a. General

(1) The COMMEL Model, described in this manual, is a research tool for use by scientists, engineers, systems designers, and operations research personnel in the study analysis, organization, development, and implementation of future communications-electronics (C-E) concepts and systems for Army combat organizations (division level and below).

(2) The primary function of the model is to provide the user with a dynamic, ground combat environment in which the effect on division level combat of a proposed C-E concept can be observed in detail. The model can be used to explore the fundamental characteristics and qualities of combat communications phenomena in a variety of conditions.

(d) Maneuver:

1. Offense to include advance to contact, penetration, exploitation, and reconnaissance in force,

2. Defense to include delaying action and withdrawal,

3. Commitment and withdrawal of companies, commitment of reserve battalions and brigades, and allocation of artillery and other support from reserves,

4. Selection of lines of departure, route, and objective, and

5. Movement and deployment of General Outpost (GOPs), special units, rear echelon elements, and reserves.

(e) Communications of all types:

1. Specific, tactically essential messages whose individual delivery affects the course of combat,

2. General tactical and logistical messages whose aggregate performance is applied eventually as a coefficient of effectiveness to fires of front line units,

3. Complete representation of the operational capabilities of any type communications system in a combat environment, (e.g., it suffers attrition, moves, can be jammed).

(f) Combat surveillance, target acquisition, and

(g) Route selection as a function of terrain and intelligence.

(h) Electronic Warfare (EW):

1. Electronic countermeasures (ECM) through the effects of communications jamming.

2. Electronic support measures (ESM) utilizing direction finding (DF) techniques against communications.

(6) The model consists of a large collection of small computer subroutines each of which represents some specific combat phenomenon and uses and operates independently on a common store of data. Hence any of

information transfer, which appear as a large number of individual entries on a "message list," and then simulates the delivery of the message through the system described as a collection of "arcs" connecting communicating "nodes." The arcs may be unusable due to busy studies, wire outage, out-of-range, interference, lack of special messengers, etc., and the nodes may be incapable of handling the messages due to equipment failure, damage by enemy fire, long queues, nonavailability of encrypting equipment, (displacing), etc. When the message is delivered in time, it is assigned to the message in the list. Finally, when that time is reached by the clock keeping track of combat time, the action which is dependent on the delivery of the message is permitted to take place.

(3) During the play of a tactical simulation, the model outputs data that can be used to determine tactical progress, success or failure to gain objectives, casualties, equipment attrition, and combat time. In addition to tactical data output, data on the performance of the communications system are generated in the model output.

(4) When the EW environment is simulated, the model tags certain tactical events (e.g., artillery strikes) so that the incremental contribution of EW can be measured. In addition, data on the performance of direction finding (DF) systems are printed in the simulation output.

3. Simulation Procedures

a. Normal use of the simulation involves the following sequence of events:

(1) The problem area is established as one in which combat dynamics are an integral part of the measurement or evaluation process.

(2) A simulation is designed in the form of a combat action that will produce the events from which a judgment can be made.

(3) A scenario is written in the form of a battle between forces of suitable size and complexity (usually division level). Corresponding Tactical Input Data are prepared. Described in detail in the input data are the terrain of

the battle area, the organization of the forces on each side, their deployment, strengths, rate of movement, objectives, lines of departure, the ranges, effectiveness and vulnerabilities of weapons, and the decision parameters.

movement rate parameter, and the Force-Ratio (FR) are developed.

g. Section 8 discusses the methods by which the model determines which units are in contact (that is, close enough to the enemy to have an opportunity to bring fire to bear), describes the selection of parameters, and provides limits used by the contact routines.

h. Section 9 discusses the acquisition, interpretation, and dissemination of intelligence by front line and long-range surveillance units.

i. Section 10 describes the basic module representing front line, close combat fires.

j. Section 11 discusses the four artillery modules.

k. Section 12 covers the modules which make the tactical decisions at battalion, brigade, and division headquarters, and the general outpost units.

l. Section 13 describes the message generation procedure, including both tactical and subtactical (STM) (not tactically essential) messages, gathering together in one section information and descriptions which appear throughout the model.

m. Finally, Section 14 describes the methodology for simulating electronic warfare effects, including both electronic countermeasures (ECM) and electronic support measures (ESM).

(2) It is forwarded to battalion headquarters, where it is assimilated, interpreted, and used as a basis for battalion level decisions (at which point it can be said to become intelligence).

(3) It is forwarded to the appropriate FDC, where it constitutes the basis for fire mission decisions.

4. Long Range Surveillance

a. Two subroutines simulate the acquisition of intelligence about enemy units behind the line of contact. This information is gathered by surveillance radar and photo reconnaissance.

b. Each of the surveillance equipment types is defined by a set of values representing its ability to acquire useful information about enemy units. This acquisition rate is determined by the long range surveillance device capability as a function of observer type, e.g., radar, mortar locator, and as a function of range of the device, the terrain of the observer, the terrain of the object, the strength and type of the observed unit, and the distance apart.

c. The logic for long range intelligence and the best method for developing input factors for long range intelligence follow:

(1) The logic (using program variable names) of the FARSEE subroutine, first computes the term SURANG for a device of type J detecting a unit of type I on side ("mode") K.

$$\text{SURANG}(I,J,K) = \frac{\text{SRV}(I,K,J) \times (.5) \times (\text{SAWTER}[1] \times 1./\text{MAXRNG}[K])2}{\text{STHN}(I,K) \times (1. - \text{SRV}[I,K,J])}$$

Where:

STHN (I,K) = Nominal strength (total combat value) of a unit of type I and mode K. (Mode 1 = Blue, mode 2 = Red). Input from Data Block EG, cc. 6-13.

SRV (I,K,J) = The LR intelligence increment picked up by a surveillance device of type J during 15 minutes detection of a unit of type I and mode K. Input from Data Block EG, cc. 14-69.

SAWTER (L) = A factor which degrades basic LR intelligence according to the terrain class L, of the observed unit. (Terrain class 1 = flat). Input from Data Block FA, cc. 29-34.

MAXRNG (K) = A surveillance distance parameter for a detected unit of mode K. It has no "real world" meaning.

(2) Having computed SURANG (I,J,K), FARSEE calculates the LR intelligence generated in 15 minutes by a device of type J detecting a target unit of type I and mode K located D km away (from the device) in terrain class L. This calculation is as follows:

Let CURR (I,K) = The current strength (combat value) of the target unit.

NUM (K,L,D) = .5 x SAWTER(L) x D2/(MAXRNG[K])2

DEN (I,K,K) = CURR (I,K) x SURANG (I,J,K)

then SURV (I,J,K,D,L) = LR intelligence in 15 minutes

= 1./([NUM(K,L,D)/DEN(I,J,K)] + 1.)

(3) Appropriate values of the input factors SRV and STHN can be determined through the following calibration process. These factors are for tactical data block EG. Additional details can be found in Appendix D, Volume III.

(a) Establish a set of strengths (combat value) representative of units in the simulation.

(b) Establish a trial set of "calibration strength values" - STHN(I,K) in the above formula for SURANG.

(c) Establish a trial set of "intelligence increment inputs" - SERV(I,K,J) in the formula for SURANG.

(d) For each combination values in (a), (b), and (c), compute the implied LR intelligence increment, SURV(I,J,K,D,L), as noted in (1) above and graph this as a function of distance and terrain.

(e) Choose the most tactically appropriate curves in (d) and use the corresponding values from (b) and (c) to set inputs for Data Block EG.

(3) The combined entry for fire consists of the sum of the amounts of fire of all the entries on a given target. The entry for intelligence weights the individual intelligence entries by the corresponding amount of fire.

b. Damage. - The damage inflicted by artillery depends on the accuracy of the fire, the amount of fire, and the vulnerability of the target. The level of damage is dependent upon the amount of intelligence on the target (from the damage assessment list), the amount of fire which is represented directly (also from the damage assessment list), and the target vulnerability which is directly proportional to the strength per unit area of the target and is influenced by the unit type and whether it is attacker or defender.

c. Suppression

(1) An important effect of artillery fire on a target unit is its suppressive effect on the unit's movement and firepower. This effect may persist for some time after a fire mission.

(2) In the model this effect is played by using a pair of numbers for each unit (the CEF list). These numbers are the suppression factor and the time applicable. They are applied against unit move rates, the direct fire allocated, and the artillery fire (for artillery units). If the time applicable exceeds the current game time, the suppression factor multiplies the move rate of the unit, the direct fire it delivers, and, if it is an artillery unit, the artillery fire it delivers.

5. Electronic Warfare

The COMMEL II.5 Model provides for a link between the Div Arty CP and the EW units providing direction-finding (DF) intelligence. When the DF option is played, the DF units generate intelligence. This DF intelligence is subsequently transmitted from a collection center to the Div Arty. There, the DF intelligence is merged with collateral intelligence and is used by Div Arty to assign priorities to potential General Support targets. A full description of the EW interaction with artillery can be found in Section 14.

CHAPTER II
THE TACTICAL SIMULATION

SECTION 14
ELECTRONIC WARFARE METHODOLOGY

1. Purpose. - This section describes the COMMEL II.5 Model simulation of electronic warfare (EW). The term EW includes use of electronic countermeasures (ECM) and electronic support measures (ESM). The aim of this simulation is the plausible representation of EW on combat outcome through interaction with communications.

2. EW System Representation. - For purposes of feasibility in modeling, the EW operational aspects were condensed as follows:

a. ECM.

(1) ECM (jamming) is used to neutralize enemy communications links. Jamming is of limited duration on any single channel since the user can shift frequency. Ideally, a single jammer will have sufficient bandwidth to render several channels unusable. With sufficient saturation, ECM can degrade the flow of information among enemy units.

(2) The ECM feature of the model allows jamming of enemy radio nets. Model input designates the radio nets (by arc types) against which jamming is to be directed. Based on the assessed effectiveness of jamming (expressed as the probability of a susceptable arc being jammed), the model randomly selects the appropriate number and types of arcs to be jammed. Each selected arc is jammed for 15 simulated minutes. At any instant of game time, only the specified (input) proportion of arcs are jammed.

b. ESM. The uses of intercepted signal intelligence (SIGINT) are extremely broad. Much SIGINT utilization requires the integration of collateral intelligence sources before use. One major SIGINT capability in combat is the accumulation of combat information through the use of direction-finding (DF) sensors (i.e., ESM). A triad of DF sensors might reasonably be deployed near the forward edge of the battle area (FEBA). Each sensor acquires DF intelligence by the sensing and analysis of enemy radio signals. Periodically, the DF intelligence generated from all sensor units is merged with collateral intelligence. Commanders can use the DF intelligence as combat information for artillery targeting or as intelligence for tactical operations.

(1) Intelligence-DF Integration. The long range intelligence routine (FARSEE) uses input factors describing a set of long range intelligence devices and their sensing characteristics. Intelligence is collected and relayed upward at simulation intervals of 15 minutes. The sensor information acquisition rate is determined by the inherent sensor sensitivity, composition (type and strength) of the unit detected, its distance from the sensor and the nature of intervening terrain. Subsequent to acquisition, each sensor unit relays its intelligence to higher echelons where it is merged with information from other sources (e.g., short range forward observers). Intelligence is a factor in artillery targeting, generation of status reports and in commit/decommit actions. In addition, the level of intelligence directly affects movement status and attrition rates.

(2) DF. Much of the intelligence process described above is applicable to DF acquisition. However, a DF sensor when suitably placed will have minimal short range terrain interference. Also, the sensing process must interact with the message traffic in the communications environment. To accommodate these requirements, special sensor devices representing the DF system were incorporated into the FARSEE routine. These special devices operate much like a standard long range sensor, except that terrain interference is minimized. In addition, a time-dependent link was established between the tactical and message processor submodels. The link makes the DF intelligence rate dependent on the time since the last radio transmission by the detected unit. The type of radio to be scanned (e.g., SSB, FM) was also added as an input. COMMEL provides for the merging of intelligence and its fading, i.e., its perishing value with elapsing time. The artillery targeting subroutines include evaluation criteria for target determination using DF intelligence.

3. ESM Logic. - The ESM simulation represents a triad of divisional electronic warfare (EW) units. Each EW unit possesses one DF sensor. The ESM system features were represented by a DF intelligence event chain. The chain begins with sensor acquisition of DF information and ends with the formation of artillery target lists incorporating the new intelligence. The chain is described as follows:

a. Acquisition. In the DF intelligence acquisition routines, sensor intelligence (detection) levels are between 0 and 1. Plausible DF detection probabilities result from scaling these intelligence values. Three DF sensors, deployed in the General Outpost Line (GOP) operate independently of each other. A sensor scan is performed at 15 minute intervals of game time. In each scan period, COMMEL II.5 initially assesses the number of conditional good fixes on a unit. These are based on sensor sensitivity, distance and unit type.

b. Intelligence Assessment and Transmittal. For each unit, a 'collection center' located at one of the EW units subsequently determines whether it has at least two good fixes. If not, no actions or effects result on that unit due to insufficient information. The initial fixes are also conditioned on associated electronic emissions. Therefore, in addition to two conditional good fixes, a unit must have generated a message in one of the scanned radio modes within the past hour.

b. Intelligence Assessment and Transmittal. The intelligence collection center merges DF intelligence passed by all three units during the acquisition phase. The merged intelligence is adjusted so that it is greater for units detected with three fixes than with two. A DF intelligence adjustment is also made on the basis of time elapsed since the last radio transmission from each detected unit. An input factor reduces DF intelligence level with increasing time since last transmission. The intelligence on all enemy units is assessed and adjusted during each 15 minute (simulated time) sensor scan period. At the end of the period, if DF activity has acquired information on at least one enemy unit, the collection center transmits an intelligence message toward the division artillery command post (CP). If this message is blocked, the CP must act on old information. The model continually degrades "aging" intelligence to reflect its time perishability, so its update and renewal are vital.

c. Intelligence Events at Division Artillery. Upon receipt of a DF intelligence message, the Div Arty CP merges that intelligence with intelligence collected from other sources (e.g., radars and forward observers). In the merge process, intelligence overlap is taken into account on a unit by unit basis through the formula:

$$Im = Io + Id(1 - Io)$$

where

Io = old total intelligence on unit

Id = new DF intelligence on unit

Im = merged intelligence on unit.

After processing the intelligence, the CP assigns priorities to potential General Support (GS) artillery targets. Components of artillery target value include intelligence level on the target, range, and suitability. Additionally, the target value is enhanced by the number of good fixes on the target and the type (and hence composition) of unit detected. The EW enhancement factors are defined in input data. Target value is greater with three DF

fixes than with only two. The degree of enhancement is also a function of the unit type (i.e., composition) of the target. The Div Arty CP then ranks the potential targets according to their value and assigns priorities.

d. Effects. The logical event chain described above should produce certain predictable simulation effects. The sensor acquisition rate is range and radio dependent. No DF intelligence is generated if a target unit is silent or out of range. Units within sensor range and transmitting on radio nets are more likely to be targeted by artillery. If struck, these units may suffer extensive damage since artillery damage depends in part on target intelligence which is enhanced by the DF process. Movement of target units is degraded due to heavier attrition influenced by added DF intelligence. Performance of the communications system may be degraded depending on the communications links through units which are struck and attrited.

4. ECM Logic. The simulated ECM is generated through subroutine JAMMING. This routine is activated at 5 game minute intervals by the model executive programs. At that time, each net is checked for the following:

a. If the net is not single channel, it is not jammed.

b. If the net is single channel, the arcs (links) of the net are checked to see if they are of the arc types targeted for jamming. The associated type codes are input in the model parameter cards (Appendix D).

c. If the net contains targeted arcs, a random draw is made from the distribution for 'percent of arcs jammed'. This distribution is input in the model parameter cards (Appendix D).

d. If the random draw determines a 'jammed' arc, the net is flagged for a movement check. The movement check determines if the end units of the flagged arcs have both been stationary for a designated minimum time (set in parameter cards). If either end unit has not been in place long enough, the associated arc is not jammed.

The arcs which satisfy all of the above conditions are set in an 'arc inoperative' status for 15 game minutes. At the end of that time, service will be restored unless further jamming has intervened.

5. Input Data.

a. The categories of specific DF input factors and a description of their quantification are as follows:

(1) Sensor Units. The sensors are organic to the force. DF sites are located with three units on the GOP. One of them serves as a collection center which transmits the DF intelligence upward to the artillery CP.

(2) Sensor Characteristics. Only one type of DF sensor is used. Its response characteristics are the same in each DF unit. Through appropriate scaling, DF sensor intelligence is related to a detection probability. The transformed sensor input then reflects a functional relationship between detection probability and sensor-target distance.

(3) Good Fixes. The basic DF intelligence acquired by an individual sensor is considered to be a good fix only if its associated detection probability is greater than 0.10. At least two good fixes are necessary for DF intelligence to be generated.

(4) Intelligence Enhancement and Good Fixes. The DF intelligence confirmed by all three sensors (i.e., with good fixes) is valued 50 percent greater than that determined from only two good fixes. There is no effect from less than two fixes.

(5) Intelligence Enhancements and Emitters. No DF intelligence is produced on a target unit which has generated no radio messages for over an hour. When intelligence is produced, its level is affected by the elapsed time between the last radio transmission of the detected unit and the DF event. There is an intelligence attenuation with age which reflects the perishability of emission information. A dynamic adjustment is possible since the COMMEL II.5 Model maintains a continual record of the time of the last radio transmission from each unit.

(6) Artillery Target Factors. Artillery target values are adjusted according to the number of good DF fixes. Targets with three good fixes are valued more than those with only two. The target value can also be varied according to unit type.

b. A detailed description of input data parameters is found in Appendix C and Appendix D.

6. Limitation. While the EW portion of the model is coded to simulate either or both Blue and Red (similar to the communications simulation), UNIVAC 1108 core size limitations preclude two sided EW play as well as communications simulation for both Blue and Red. Thus, input data must reflect either Blue communications/Red EW or Red communications/Blue EW; but not both sets. The model data base is presently set up for Blue communications/Red EW.

TABLE IV-57, Supplemental Descriptions for Data Block EG (Columns A-C)

Number of Entries: For columns A and B and for all subcolumns of column C, enter one value for each unit type.

Entry Column	Description
A	Enter '1' for attacker mode designation.
B	This value is a parameter in an intelligence determination formula. As such, it is separated from a 'real world' significance in terms of Red unit strength. Intelligence is sensitive to values in this column and those of column C.
C	These values represent the intelligence picked up by a Blue long range surveillance device of the specified type in 15 minutes of flat terrain at 1 km distance from a defender unit of the specified type. This column cross-references with column D of block LB. The seventh subfield of this entry (unit type) is reserved for description of Red DF sensors when the Red ESM option is used. Specifically, the value in cc. 62-69 is the base intelligence generation rate of the Red DF device against each unit type. Refer to Section 14, Volume II and Appendix D, Volume III for additional detail.

TABLE IV-71, Supplemental Descriptions for Data Block LB

Number of Entries: For each column, enter as many values as there are surveillance pairs. A surveillance pair consists of a unit with long range surveillance capability and the headquarters to which it reports. These must be no more than a combined (Red plus Blue) total of 48 surveillance pairs in this block. The number of Blue surveillance pairs is given in line 26 of data block CC.

Entry Column	Description
A	Designate the number of the reporting unit of the surveillance pair, i.e., the unit at which a long range surveillance device is located. The first three values for this item are not used. The fourth through sixth values must be the Red units possessing the EW sensors.
B	Designate the unit to which the unit of column A reports. This unit must be a division, brigade, or group CP, a direct support FDC or a div arty CP. The first three values for this item are not used. The fourth through sixth values should be the unit number of Red Div Arty to which Red DF units report.
C	The message type (DLINE index) code used in data block NA to identify long range surveillance messages. The fourth through sixth values of this item should be '24' for the Red DF message type.
D	Type of surveillance device at the unit of column A. The device codes are those used in data block EG. The fourth through sixth values of this item should be '7' to denote a Red DF surveillance device.
E, F	These entries apply to the unit of column B. A key for these codes is in the first form for this data block. The fo/urth through sixth value for item E should be '2' because Red DF goes to Red Div Arty. The corresponding values for F should be '1' in that case.

The first six surveillance pairs of this block are reserved exclusively for description of electronic warfare units using direction finding. Of these, only pairs four through six, corresponding to Red DF sensors, are operative in COMMEL II.5. Additional detail is given in Appendix D of Volume III.

DATA BLOCK EG

Cols. 1-2	TINO 16,A,B	Mode	(I2)
Cols. 4-5	TINO 16-A,B	[J]	(I2)
Cols. 6-13	TINO 16-A,B	Strength	(F8.0)
Cols. 14,69	TINO 16-A,B	Surveillance device types	(F8.3)
Cols. 74-75		"EG"	(A2)

APPENDIX B
PREPROCESSOR

1. The model is fed data by three different preprocessors, each corresponding to one of the three basic data areas: tactical, communications, and subtactical messages (nonessential tactically). Each preprocessor reads input data and produces intermediate files that are read by the simulator. The data blocks that are read by each preprocessor are easily determined by examination of the sample runstreams in this section.

2. The communications preprocessor is run twice; once for attacker input data and once for defender input data. The data decks and their ordering are as shown in Chapter V, Para. 3. The STM (background traffic) preprocessor is run once and may include both attacker and defender data. The ordering of STM data input is given in Chapter V, Para. 4. The tactical preprocessor is run once using the data set listed in Chapter V, Para. 2b.

3. The file and element names used in the sample runstreams are not rigid. The model user should construct his own program and data files and his runstreams should be compatible. A set of data and program files are available on tape for a recent version of COMMEL. If requested, this tape and instructions for transfer to disk will be furnished.

4. The basic data input as described in this manual is set up for Blue forces in the offense mode. The input data for the tactical preprocessor must be altered extensively if the mode of the forces is switched. Movement factors as well as mode parameters must be changed. An example of the required revisions when switching from a Blue offense scenario to a Blue defense scenario is given in Appendix F.

APPENDIX C
SIMULATOR

Most of the EW input factors in COMMEL II.5 are read through the parameter card by the MIM executive routine. The structure and format of COMMEL II.5 parameter cards is given below.

COMMEL II.5 Parameter Cards

These variables, read in at execution time, determine options for running of the simulator. Following is a description of these input cards with a definition of each parameter.

Card 1

Col.	Name	Format	
1		I1	"1"
5-12	SIMID	A6,A2	Six character run identifier.
16	KSAMPL	A1	Game option: 1 = Tactical play only, 2 = Red and Blue commo play (not operative on the UNIVAC 1108 version), 3 = Blue commo play, 4 = Red commo play.
20-23	PSTART	I4	Game start time (in minutes). Set to "0".
27-30	KGSTOP	I4	Game stop time (in minutes).
34-35	KOMPER	I2	Time (in minutes) between restart dumps.
39	NTACT	I1	0 or blank = No translation done, 1 = Translate binary tactical output. Always set to "0".
51	NREAD	I1	1 = Unit names read from disk file. 2 = Unit names read from disk file. 3 = Unit names not translated. Always set to "2" for UNIVAC 1108 runs.

Card 2

Col.	Name	Format	
1		I1	"3"
6-10	DCRMT1	F5.3	Frequency of translation for selected tactical arrays.
13-17	DCRMT2	F5.3	Number of Messages over which to take moving average for STM performance.
20-24	DCRMT3	F5.3	Number of minutes in current period.
27-31	DCRMT4	F5.3	Base factor used in STM impact calculation.
34-38	DCRMT5	F5.3	Minutes over which to compute moving average.
41-45	DCRMT6	F5.3	Weighting factor for STM impact on committed units in contact.
55-59	FAILCN	F5.3	On/off switch for STMGEN. FAILCN = 0 or blank means "No STM". STM traffic is generated if FAILCN is unequal to 0.
62-66	PCONVR	F.5	On/off switch for COMSYS. 3.0 = No COMSYS play (any other value has no effect).

Card 3

Col.	Name	Format	
11-15	INTD	I5	INTD greater than 0 means "play Blue DF capability". INTD = 0 means "no Blue DF capability". Set to 0.
16-20	INTR	I5	INTR greater than 0 means "play Red DF capability". INTR = 0 means "no Red DF capability".
21-25	ZLIM	F5.3	A DF device has a good fix on a detected unit only if the DF intelligence level on that unit exceeds ZLIM.
26-30	ZNTMN	F5.3	DF intelligence is not passed on to Div Arty unless at least ZNTMN (amount of intell) has been collected on at least 1 unit.
31-45	FAC(I) I=1,3	3F5.3	A multiplicative adjustment of DF intelligence on a unit. FAC (I) is based on the occurrence

of I 'good fixes' on the unit. Typically $FAC(1)=0 \le FAC(2) \le FAC(3)$

Card 4

Col.	Name	Format	
1-20	ICEW(I) I=1,4	4I5	Designate the mode/usage codes (see Table IV-93) for the message types which are to be intercepted by DF devices.
21-25	SFAC(1)	F5.1	If Blue DF is used, set SFAC(1) equal to the value of TWT(I,J) (see cards 6-8) which, when exceeded by a DF target, will assign highest artillery target priority.
26-30	SFAC(2)	F5.1	If Red DF is used, set SFAC(2) equal to the value of TWT(I,J) which, when exceeded by a DF target, will assign highest artillery target priority.

Card 5

Col.	Name	Format	
1-50	TFAC(I) I=1,10	10F5.3	Multiplicative DF intelligence factors which reduce DF intelligence with increasing time since last radio transmission from a unit. TFAC(I) references a 10 minute interval during which a target unit last transmitted. The interval for I=1 is the most recent 10 minutes; the interval for I=9 is between 80 and 90 minutes back in time.

Card 6

Col.	Name	Format	
1-50	TWT(1,J) J=1,10	10F.3	A weighting factor (20) which, when added to 1, becomes a multiplier of artillery target value for a unit of type J on which DF intelligence has provided exactly one good fix. Note: The model weights zero good fixes and one good fix equally.

Card 7

Col.	Name	Format	
1-50	TWT(2,J) J=1,10	10F5.3	Analogous to TWT(1,J) of Card 6 except that TWT(2,J) applies to target units with 2 good fixes.

Card 8

Col.	Name	Format	
1-50	TWT(3,J) J=1,10	10F.3	Analogous to TWT(1,J) of Card 6 except that TWT(3,J) applies to target units with 3 good fixes.

Card 9

Col.	Name	Format	
1		I1	"4"
9-20	SEED	012	Random number seed (must be both odd and octal).
21-30	AVGJAM	F10.0	Mean of probability of an eligible arc being jammed.
31-40	STDJAM	F10.0	Standard deviation of probability of an eligible arc being jammed.
41-43	JAMDLY	I3	Delay time after a unit is placed before an eligible arc can be jammed.
44-46		I3	Number of arc types to be jammed.
47-76		10I3	Types of arc that can be jammed.

Card 10

Col.	Name	Format	
1		I1	"5"
5-8	MPSTRT	I4	Time (in minutes) map plots begin.
19-22	MPINCR	I4	Time (in minutes) between map plots.

Card 11

Col.	Format	
1	I1	"9"

The @XQT card of the simulator runstream may have the following options appended. The C option prints all reports of the B option plus the various intelligence summaries. Do not use options B and C simultaneously. A run with the "works" including dumps would have @XQT, ACDEIMTJ 91COMELABS.ABS. To run a case with jamming, the J option must be set. A complete basic run stream follows below.

A - Print ARC reports
B - Print TWRITE reports at specified periods
C - Print all TWRITE reports
D - Print Dump at end of run
E - Print EXTRAC report
I - Print Dump at beginning of run
M - Print Message Traffic report
T - Print timing messages
J - Activate the jamming routines

Run Stream for Simulator

```
 @RUN,/TPR       D5919G4375T5097, UNCLASSIFIED,240,1000
 @HDG,P  TEST OF COMMEL (8 HOURS) ***UNCLASSIFIED***
 @ASG,A  BLUCOMFILE.
         Attacker communications input file (output
from COMINP.)
 @ASG,A  REDCOMFILE.
         Defender communications input file (output
from COMINP).
 @ASG,A  STMFILE.
         STM input file (output from STMINP).
 @USE,11 STMFILE.
         Assign logical unit to STM input file.
 @ASG,A  TACFILE.
         Tactical input file (output from TACINP).
 @DELETE,C     PLOTFILE.
         Delete file if already created.
 @ASG,UP PLOTFILE.
         Plot output file.
 @USE    15,PLOTFILE.
         Assign logical unit 15 to plot output file.
```

```
 @USE     10, TACFILE
          Assign logical unit 10 to tactical input file.
 @USE     9, REDCOMFILE.
          Assign logical unit 9 to defender
commnications input.
 @USE     8, BLUCOMFILE.
          Assign logical unit 8 to attacker
communications input.
 @ASG,T   34.,F40///4000
          Temporary file for arc report.
 @ASG,T   35., F40///4000
          Temporary file for traffic report.
 @XQT,BD 91COMELABS.ABS
            Run simulator with options B and D.
1 BENCHMRK     1      0      481   600  0      0      2
3  60                                                 1.
4   000000001111        0.1      .0125 65 01 15
5   1     390    60      80      40      200000      5.0 5.0
9
MIM parameter cards.
@PMD,E
Dump if error aborts program.
@ASG,T TAPE., 8C9, SAVEW
          Assign tape to save output of run.
@COPY,GM 8.,TAPE
          Save attacker communications input (file 1).
@COPY,GM 9.,TAPE
          Save defender communications data (file 2).
@COPY,GM 10.,TAPE
          Save tactical input (file 3).
@COPY,GM 15.,TAPE
          Save input for plot program (file 4).
@COPY,GM 34.,TAPE
          Save arc report (file 5).
@COPY,GM 35.,TAPE
          Save traffic report (file 6).
 @FREE    PLOTFILE.
 @START   START*91START.PLOT-RUNX
          Start plot program.
 @FIN
```

MAP PLOTS

An additional output option that is available is the capability to produce map overlay plots of all Red and Blue units showing the center of mass. Currently, plots are available at scales of 1:250,000 and 1:50,000. Plots at a scale of 1:50,000 include unit numbers. The time interval between plots can be as small as every 15 minutes.

Following is an example of a 1:250,000 map plot of Red and Blue units at time T = 0 hours.

Note: Blue units are on the left and are designated by crosses. Red units are on the right and are designated by circles. Due to the scale, units numbers are not shown on 1:250,000 plots.

The COMMEL II.5 Model generates output which can be used to produce plots. The timing of these plots is regulated by parameter card 10 of the Simulator runstream for COMMEL II.5. The plots are done by a CALCOMP plotter using the saved output of logical unit 15 from the Simulator. The Simulator program saves this output on the third file of an output tape.

There is an option available on the @XQT card of the plot program. Use of option 'G' will cause a grid network to be overlaid on the plot. Without this option, only the unit locations and the coordinate axes will be displayed.

Four data specification cards follow the @XQT card. Their order and formats are as follows:

CARD 1

Columns	Format	Definition
1-40	8A5	Title - will be printed on plot.

CARD 2

Columns	Format	Definition
1-7	F7.0	Map scale - Use 50000. or 250000.

CARD 3

Columns	Format	Definition
1	I1	Number of plots to be output.

CARD 4

Columns	Format	Definition

DATA Times at which plots are taken. These must be in chronological order. The times must also be equal to 1 plus a multiple of the second data entry (MPINCR) of MIM parameter card 10.

The output from logical unit 15 of COMMEL II.5 is added after the last data specification card. This file must be saved in order for plots to be postprocessed.

APPENDIX D

INPUT FOR ESM IN COMMEL II.5

APPENDIX D
INPUT FOR ESM IN COMMEL II.5

D-1. General. - There are four types of input data: tactical, communications, background traffic and parameter cards. The ESM data of COMMEL II.5 is incorporated into the parameter cards and the tactical data input. The data sets for communications and background traffic are left unchanged.

D-2. Tactical Data Blocks. - Only two of the 37 tactical data input blocks are involved with ESM data, i.e., blocks EG and LB. One of the device categories of block EG has been reserved for defining a DF sensing device in COMMEL II.5. The format for a data card in that block (EG) is shown on page V-36. The overall block structure is described on page IV-112. Tactical data block LB describes units possessing surveillance devices. The first six units designated in the block are reserved for EW units using direction finding (DF). Only the first two records of the block contain EW inputs. Their formats in COMMEL II.5 are reflected in page V-37. The new item definitions for EW are shown in page IV-112. The rest of the block is unchanged.

D-3. Calibration of ESM Data. - The "base intelligence generation rate," of "base rate(I)," for unit type I, input in columns 62-69 of block EG must be chosen according to the following procedure. First a representative strength in terms of combat value must be input for each enemy unit type in columns 6-13 of block EG. For each enemy unit type I with strength STH(I), compute:

SUR(I) = ["base rate(I)"] 4/ [STH(I)*(1.-"base rate(I)"]

then, for a sensor-target separation distance of D km, the DF intelligence level from a transmitting target of type I with current strength (combat value) CURR(I) is:

$$INT(I.D) = [CURR(I)*SUR(I)]/[CURR(I)*SUR(I)+4*D^2]$$

If CURR(I) is set equal to STH(I), then the value of "base rate(I)" should be selected so that INT(I,D) represents a reasonable intelligence-distance relationship. The implied curve may be scaled by a constant factor.

D-4. Parameter Cards. - Most of the input factors for EW are entered into the parameter cards read by the MIM executive routine of COMMEL II.5. The complete structure of parameter cards is shown in Appendix C; ESM input being contained on Cards 3-8.

APPENDIX E

PARAMETERIZATION OF THE COMMEL II.5 MODEL

APPENDIX E
PARAMETERIZATION OF THE COMMEL II.5 MODEL

E-1. Background. - Several hundred array variables are used in the COMMEL simulator. In order to facilitate changing the dimension specifications for these arrays, the model was parameterized. Parameterization here denotes the representation of many subscripts as integer parameters which can be set by the user. A saving in user labor results because several arrays with a common subscript size can be redimensioned through a revision of one variable - the associated subscript parameter. The core memory required by the simulation will vary depending on the settings of the subscript parameters. The settings should be structured according to the data requirements of the individual scenario.

E-2. Operation. - The subscript parameters are set in the PROC routine of the simulator. Currently 23 subscript parameters are designated in COMMEL II.5. If any one of these is reset, all simulator routines must be recompiled prior to being remapped. The subscript parameters may be used in program code (for example, as indexes of DO loops). The following list comprises all the COMMEL II.5 simulator arrays with subscript parameters. The subscript parameters appear as names of the form MXXX, where XXX is an integer.

PARAMETERIZED COMMEL II.5 SIMULATOR ARRAYS

ARCLOG (M890,9)
BATTCO (M5,5)
CMPLOG (M90,3)
CONAME (M10,4)
CONCOS (M20)
CONDLY (M20)
CONECT (M390)
CONTC1 (M60)
CONTC2 (M120,6,3)
COORD (M40,2)
EQPFLG (M800)
EQPLOG (M800,2)
EVNTAG (M390)
FORCE (M257,2)
INPAIR (M60,2)
INPAR1 (M60)
INPAR2 (M60,2,3)
INTBBD (M68,4)
INTBDA (M68)
INTBA2 (M136)
INTBS1 (M136,3)
INTBS2 (M136,3)
INTBGP (M68,11)
INTBLR (M68,33)
INTRBD (M61,5)
INRDA2 (M121)
INRDS1 (M121,3)
INRDS2 (M121,3)
INTRGP (M61,8)
INTRLR (M61,15)
KMAT (M20)
MSNOLG (M390)
MESGES (M51,6)
MESARC (M390,3)
MESRED (M100)
MESTAG (M390,2)
MVMSG1 (M257)
MVTIME (M257)
ARTM (M257)
PARLOG (M51,2)
PUNMUV (M20,10)
STMUNT (M310,2)
SURANG (M48,10)
UNAGIN (M257)
UTARCL (M1755,2)
BADARC (M390,3)
ARCBAD (M390)
ARCTYP (M890)
ADSTYM (M257)
ATRTLG (M257)
CHNLOG (M280,6)
CIRNDX (M280)
CURSTH (M257)
MESGEL (M51)
MESDAT (M390,3)
MESLOG (M390,6)
MVMSG2 (M257)
ORIGST (M257)
ROUTE (M400,2)
TERCLS (M80,M40)
TERNDX (M80,M40)
TYPLOG (M20,2)
UNTARC (M257,3)
UNTCRD (M257,2)
UNTDLY (M257)
UNTPTG (M257)
UNITER (M257)
UNTYPE (M257,2)
UNRDUS (M257)
UTEKFK (M257)
UTMVST (M257)
WEAPST (M257,15)
UNITNM (M257,4)
FORRAT (M257)
AATRIT (M257)
CAMAT (M257)
MATRIT (M257)
ORGRIF (M257)

APPENDIX F

DEFENSE SCENARIO WITH COMMEL II.5

APPENDIX F
DEFENSE SCENARIO WITH COMMEL II.5

The standard COMMEL II.5 INPUT DATA have Blue on the offense and Red on the defense. The input must be changed in order to create scenarios with Blue in the defense mode. The communications and STM data blocks need not be altered in this case, only selected tactical data blocks must be changed. The following list shows all tactical data blocks and the nature of changes made in applications which require a switch from a Blue offense to a Blue defense mode. The names of blocks and items correspond to those listed in Volume II, Chapter V of this report.

Data Block	Item	Changes
CC		No change required.
AA		No change required.
RB		No change required.
RA		No change required.
AA		No change required.
AB		No change required.
EB		No change required.
EM		No change required.
BA	GPMODE cc44	Change from '7' to '4' for all Blue groups except Gp 11. Change '7' to '2' for Gp 11. Change '4' to '7' for Red groups.
	GRPCRD cc62-69	Let Group 11 be a Blue GOP. Deploy it about 10 km ahead of the rest of the force. Since Group 12 is no longer a Red GOP, deploy it about 10 km to the rear of its former (defensive) position.
BB		No change required.

Data Block	Item	Changes
BC	GOPDST cc5-16	Since the new GOP is Blue, its objective should be on the left, at the rear of the Blue force.
BD	GOPINDX cc4-5	Set to '11' with Gp 11 designated as Blue GOP.
	GOPINDX cc7-8	Set to '11' with pattern 11 containing the Blue GOP.
	GOPDST cc13-16 cc17-20	Change the signs from - to +.
BE		No change required.
CA	PTRNRT cc6-9	Change from .3 to .05 for patterns with '0' in cc4 except for pattern 11 which changes from 8.00 to .45.
	PTRNTP cc4	Change from '3' to '0' for pattern 11.
	PTRNTP cc11-12	Change from '2' to '11'.
	PTRNMV cc14-17	Set x co-ord about 5 km to the left for patterns 1,2,3,6, and 7. Set x co-ord about 5 km to the right for pattern 8. Set x co-ord about 3 km to the right for patterns 31 and 33. Set x co-ord about 15 km to the right for pattern 34.
	PTRNMV cc24-27	Change from +1 to +15. for patterns 1 and 2, from +1. to 8. for patterns 3 and 6, from -1. to +5. for pattern 4, from -1. to +1. for pattern 5, from +1. to 6. for pattern 7, from -1. to 9. for pattern 9, from +1. to 5. for pattern 10, from +1. to 30. for pattern 11, from -1. to 8. for patterns 13 and 15, from -1. to 13. for pattern 14, from -1. to 6. for pattern 16, from -5 to 13 for pattern 22, from -5. to -3. for patterns 23, and 27, from -5. to -6. for pattern 24, from -5. to -1. for pattern 26, from -5. to +5. for pattern 23, from -6.

Data Block	Item	Changes
		to -1. for pattern 29, from 0 to +2. for pattern 30, from 0. to 5. for pattern 32, from 0. to 1. for pattern 33, from -5. to 10. for pattern 34 and from -5. to -3. for patterns 35, 36 and 34.
CA	PUNFLG cc49	Change form '0' to '1' for the first three units of pattern 11 - the Blue GOP.
	PUNCRD cc51-54	Redeploy units of pattern 11 (Blue GOP) about 20 km forward. Redeploy units of pattern 22 about 10 km to the Red rear.
	PUNCRD cc56-59	Redeploy about 10 km north for units of pattern 11 - the Blue GOP.
DA		No change required.
EA		No change required.
WE		No change required.
AT		No change required.
ED		No change required.
EE		No change required.
FA		No change required.
FB		No change required.
FC		No change required.
HA		No change required.
JA		No change required.
KA		No change required.
LA		No change required.
EG		No change required.
LB		No change required.

Data Block	Item	Changes
NA		No change required.
OA		No change required.
PA		Battalion 3 of Bde 3 is to be omitted since it becomes a Blue GOP. The old Red GOP must then be added as a Bn to Bde 4.
	BATOBJ cc54-57 cc62-65	Relocate the Bn objectives to the Blue rear for all battalions on both sides.
PB		No change required.
PC	BRGBAT cc34-35	Changes from '3' to '2' for Bde 3 and from '4' to '5' for Bde 4.
	BRCCBT cc40-41	Change from '5' to '4' for bde.
PD		No change required.
QA		No change required.

APPENDIX G

COMMEL II.5 OUTPUT FILES

APPENDIX G
COMMEL II.5 OUTPUT FILES

G-1. The output of COMMEL II.5 consists of one print file and seven tape files. The print output file differs from COMMEL II in the following aspects:

a. Personnel as well as materiel attrition are listed for each unit.

b. Total attrition for each unit and force are partitioned into that due to indirect fires and that due to direct fire.

c. The number and percent personnel lost are summarized for each force.

d. A Blue/Red personnel loss ratio is computed for each force.

The seven tape output files are:

a. Plot file.

b. Arc report.

c. Message report.

d. ESM report.

e. Artillery report.

f. Attrition report.

g. Move report.

G-2. The first three listed tape files are unchanged from COMMEL II. The other files are described below. The plot file in discussed on page C-5 of Appendix C. Information from the arc report is illustrated on page C-21 of Appendix C. Page C-22 of Appendix C shows data from the Message report. The purpose of these files is as input to postprocessors. The plot file, message report, artillery report, attrition report, and move report are used as input to operational postprocessors described in Appendix H. Additional postprocessors can be built to yield additional force status information.

G-3. <u>ESM Report File</u>. - The ESM report file is output on logical unit 9 of COMMEL II.5. It contains an hourly detection status for

every Blue unit relative to each Red DF sensor. The file contains one block of output for each simulated hour. Each block contains exactly 122 records. The 1st record has the game time at the end of the hour. The succeeding 121 records show Blue Unit ESM status at that time. The output blocks are in chronological order. Each block has the following structure:

1st Record

Card Col.	Format	Item Description
1-5	I5	Game time (e.g., 61,121)

2nd Record -
121st Record

Card Col.	Format	Item Description
1-5	I5	Blue Unit Number
6-15	F10.4	Intelligence level at Red Direct Support Bn #1 on this unit.
16-25	F10.4	Intelligence level at Red Divarty on this unit.
26-35	F10.2	Artillery target weight derived from direction finding (DF).
36-40	I5	Time of last radio transmission from this unit.
41-45	I5	Number of good DF fixes on this unit.
45-50	I5	Unit type.
51-57	F7.1	Distance (km) of unit from DF sensor #1.
58-64	F7.1	Distance (km) of unit from DF sensor #2.
65-71	F7.1	Distance (km) of unit from DF sensor #3.
72-81	F10.5	Unscaled intelligence on unit from DF sensor #1.
82-91	F10.5	Unscaled intelligence on unit from DF sensor #2.
92-101	F10.5	Unscaled intelligence on unit from DF sensor #3.

G-4. Artillery Report. - The artillery report lists the result of every artillery strike and indicates whether the target was based on DF intelligence. The report is output on logical unit 16 of COMMEL II.5. All artillery strikes are listed in chronological order. Each strike consists of a pair of records. The first record indicates the time of the strike. The second gives results. The pair is formatted as follows:

1st Record

Card Col.	Format	Item Description
1-7	I7	Time of strike (game minutes).

2nd Record

Card Col.	Format	Item Description
1-7	I7	The unit struck.
8-13	I6	The type unit struck.
19-20	I7	'1' = Blue unit '2' = Red unit.
22-31	F10.2	Amount of fire delivered in this strike.
37-43	F7.4	Intelligence on target unit.
50-57	F8.6	Targets fixed by the DF sensors are indicated by .02 (2 fixes) or .03 (3 fixes) in this field.
107-112	F6.2	Strength (combat value) of target unit.
117-125	F9.6	Fraction target destroyed by strike.

G-5. Attrition Report. - The attrition report is output on logical unit 17 of COMMEL II.5. This report is output at the end of every print output cycle except at time = 1. The report gives the location and attrition (personnel and materiel) for each unit. The output block for each hour has exactly one record for each unit plus 1 header card. Each block is formatted as follows:

1st Record

Card Col.	Format	Item Description
1-4	I4	Game time (minutes) - There is no output at time 1.

Records 2 thru (Nr Units + 1)

Card Col.	Format	Item Description
1-5	I5	Unit Number.
11-24	3A4, A2	Name of unit.
25-34	F10.4	Cumulative per cent materiel attrition on unit.
35-44	F10.4	Cumulative percent personnel attrition on unit.
45-54	F10.2	Amount of combat value attrited.
55-64	F10.2	Amount of personnel attrited.
65-74	F10.2	x-coordinate location of unit.
75-84	F10.2	y-coordinate location of unit.

G-6. Move Report. - The move report is output on logical unit 18 of COMMEL II.5. This report is output at the end of every print output cycle, including time 1. If there are 18 battalions in the simulation, each block of output has 19 records. Each block has the following format:

1st Record

Card Col.	Format	Item Description
1-5	I5	Game time.

Records 2
thru (Nr Bns
+ 1)

Card Col	Format	Item Description
1-3	I3	Brigade Number. (Brigades 4 and 5 are Red)
4-5	I2	Battalion Number in the Brigade.
101-104	I4	Forward Unit of Battalion.
105-113	F8.1	Distance (km) of the forward unit from the battalion objective.

APPENDIX H

POSTPROCESSORS FOR COMMEL II.5

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H-1. General. - Three postprocessors have been constructed for COMMEL II.5. These are the Message Postprocessor, the Move Postprocessor and the Artillery Postprocessor. The COMMEL II.5 outputs files described in Appendix G are input to these postprocessors. Each postprocessor is described in detail in the following paragraphs.

H-2. Message Postprocessor. - The Message Postprocessor uses the message report file of COMMEL II.5 as input. The message report file is output from COMMEL II.5 on logical unit 35. The Message Postprocessor gives print output of cumulative message status (number of messages) at the end of each game hour. The output is ordered and described as follows:

a. The records from the message report for all failed messages during the last game hour.

b. The game time over which cumulative message statistics are computed and output.

c. The cumulative number of message circuit connects in each net.

d. The cumulative number of messages generated in each precedence class.

e. The cumulative number of messages generated for each security class.

f. The cumulative number of messages generated for each mode/usage code. (see Table IV-93, page IV-194 for description of mode/usage codes)

g. The cumulative total number of messages circuit connected on each arc.

h. The cumulative number of message circuit connects on each arc.

i. The cumulative number of messages encountering a busy on each arc.

j. The cumulative number of messages encountering a circuit failure in each net.

k. The cumulative number of messages encountering a busy state in each net.

l. The cumulative number of messages encountering a busy-for each message type. (Message types are listed in Table IV-94, page IV-195).

m. The cumulative number of messages requiring a special messenger-for each message type.

n. The cumulative number of messges completions for each message type.

o. The cumulative number of message circuit connects for each message type.

p. The cumulative number of circuit fails for each message type.

q. The cumulative number of message failures for each message type.

r. The cumulative number of message pre-empts for each message type.

s. The cumulative number of message generations for each message type.

t. The number of message failures for each receiving unit.

u. The number of message failures for each transmitting unit.

In addition, the output of l. - s. above also give the cumulative total number of tactically essential and background (STM) messages separately for each category. The output is implicitly labeled by format. That is, the ordinal position of a value in an output block determines the message type, arc number, or net number it references. Ordinal position is increasing when reading left to right or reading down in a list.

H-3. Artillery Postprocessor. - The Artillery Postprocessor uses the artillery report file of COMMEL II.5 as input. The artillery report file is output from COMMEL II.5 on logical unit 16. This postprocessor can operate on two cases in one run; one case may have direction-finding (DF). The following description of print output for the postprocessor assumes that two cases are input, one for a scenario with DF (the 'EW case') and the other with no DF (the 'No EW case'). All output statistics are for the full simualtion period. In these simulations, only the Red force is given an EW capability.

a. The total number of different units struck by Red artillery in the EW case.

b. The unit numbers of the different units struck by Red artillery in the EW case.

c. The total number of different units struck by Red artillery in the Non-EW case.

d. The unit numbers of the different units struck by Red artillery in the Non-EW case.

e. The total number of Red Artillery strikes in the Non-EW case.

f. A list of information on each Red artillery strike in the EW case, including the time, unit struck, intelligence on unit and resulting damage.

g. A summary showing the number of Red strikes, the average resulting damage per strike and the average intelligence all for the EW case.

h. The information in f. and g. is given for each unit type in the EW case.

i. The information in f., g., and h. above is given for all Red strikes in the EW case on targets 'fixed' by the Red EW.

j. The information in e. through h. above is given for all Red strikes in the Non-EW case.

H-4. Move Postprocessor. - The Move Postprocesor uses the move report file and the attrition report file of COMMEL II.5 as input. The move report file is output from COMMEL II.5 on logical unit 18 and the attrition file is output on logical unit 17. In addition, card image input, as described below, is also required. The print output of the postprocessor gives statistics on each attacking (Blue) battalion at the end of each game hour. The card image input is as follows:

1st Record

Card Col.	Format	Description
1-10	F10.3	Small radius (unit contact).
11-20	F10.3	Large radius (unit contact).

Records 2-
Nr Blue
Bn +1

Card Col.	Format	Description
1-25	5I5	These are the 5 unit numbers of the units in the group comprising the nth Blue Bn, where this is the (n+1st) record. The units in the nth Blue Bn are determined from tactical data block BA. The ordering of Blue Battalions is the same as in tactical data block PA.

Records (Nr Blue Bn +2) thru (Nr Blue Bn +Nr Blue Units +2)

Card Col.	Format	Description
1-5	I5	Blue Unit Number (in order)
6-15	F10.5	Number of personnel in this Blue unit.

The following statistics are printed for each attacking battalion at the end of every simulated hour.

a. The past hour's move rate (in km/hr) toward the Bn objective.

b. The cumulative (thru this hour) personnel attrition fraction for the Bn.

c. The number of personnel casualties in the Bn.

d. The total linear distance traveled by the Bn toward its objective.

e. The percent of the initial Bn-objective distance accounted for by the Bn movement thru this hour.

f. The number of defending units within the small (input) radius of the lead Bn unit.

g. The number of defending units satisfying f. and also positioned East of the Bn lead unit.

h. Analogous to f. except for the use of the large (input) radius.

i. Analogous to g. except for the use of the large (input) radius.

APPENDIX I

SUPPLEMENTARY COMMUNICATIONS NETS PREPROCESSOR FOR COMMEL II.5

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SUPPLEMENTARY COMMUNICATIONS NETS PREPROCESSOR FOR COMMEL II.5

I-1. A special Link Preprocessor assists in preparing and checking the communications link data of COMMEL II.5. The raw communications link data is input in net clusters, i.e., all links for each net are input together. The link/net descriptors are also divided between two data blocks and are input in code. It is extremely difficult to 'size' the system using raw data because the links between any pair of specified units are not grouped and are not easily intelligible.

I-2. The Link Preprocessor accepts the raw communications link data as input and outputs the following for each pair of Blue units:

a. The names of the linked units.

b. The unit numbers of the linked units.

c. The number, type, capacity (Nr circuits) and net owner of all links between the pair of units.

d. The number of the net each link is in.

e. The number of the arc represented by each link (will cross-reference with COMINP preprocessor output).

The output has the links in numerical order relative to unit number. The inclusion of net numbers and arc number for each link enables quick reference to the associated raw data. The inputs to the Link Preprocessor program are:

a. Communications data block ARCLOG (on logical unit 7).

b. Communications data block CHANELOG (on logical unit 8).

c. Tactical data block AA (on logical unit 9).